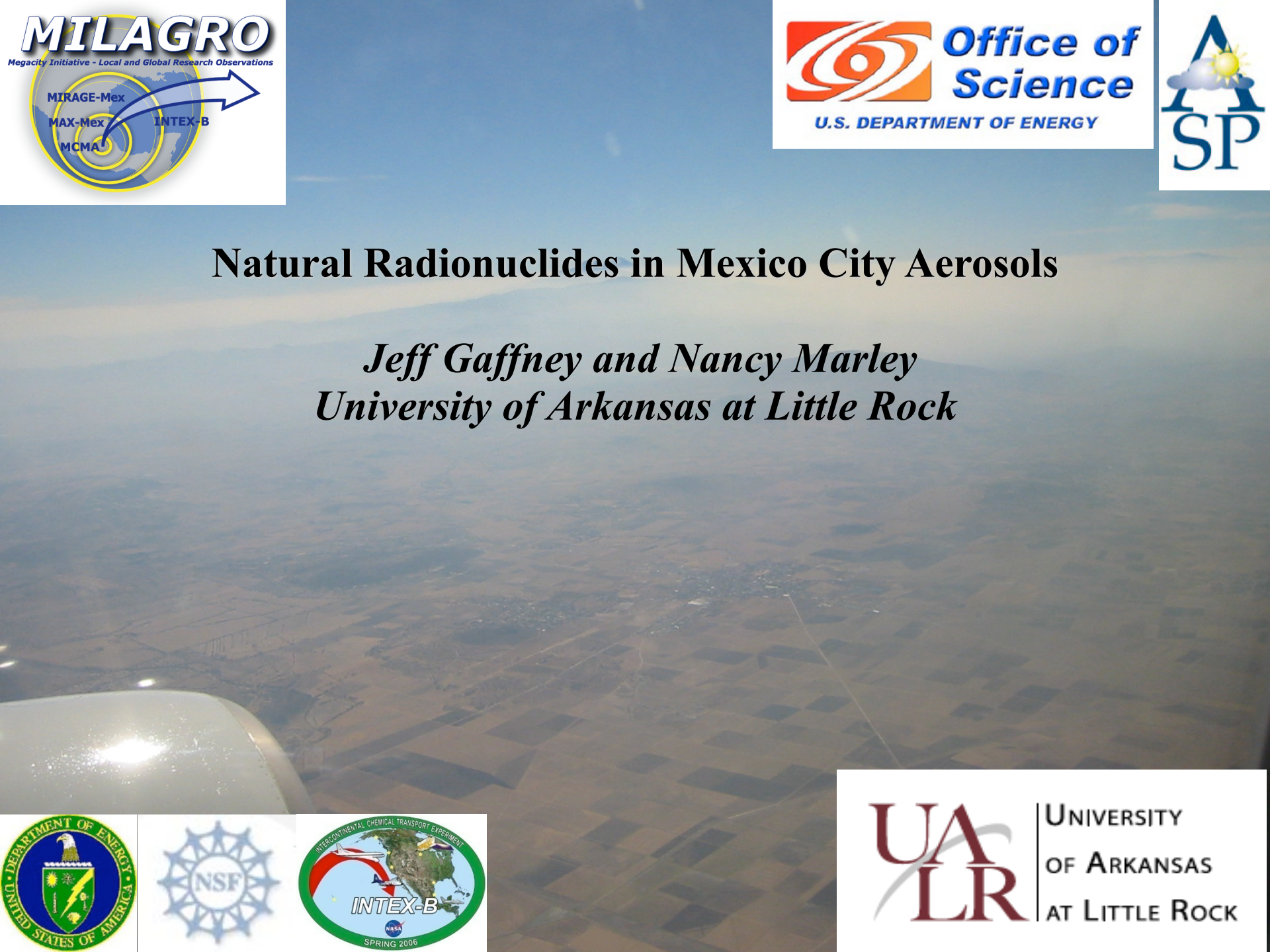
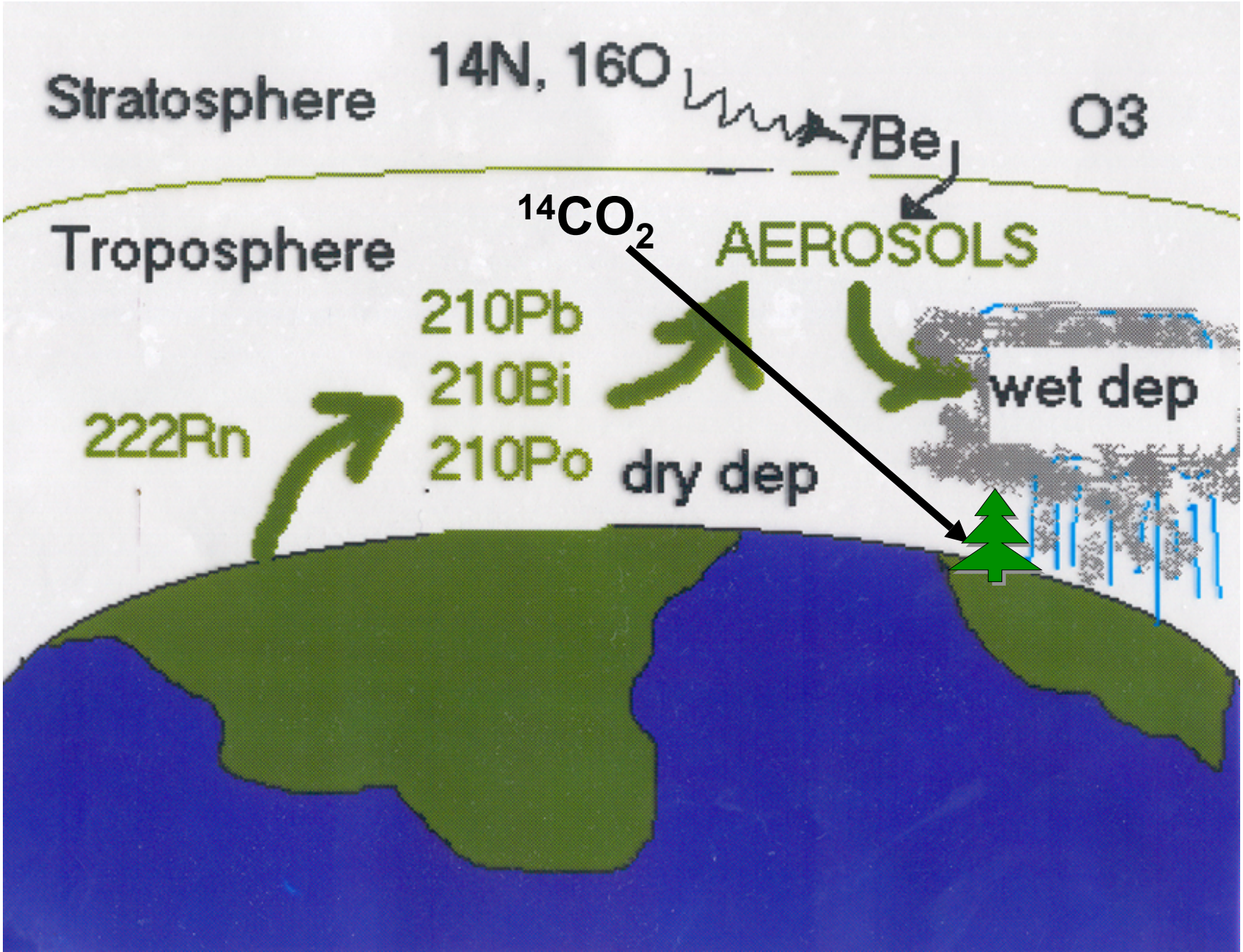


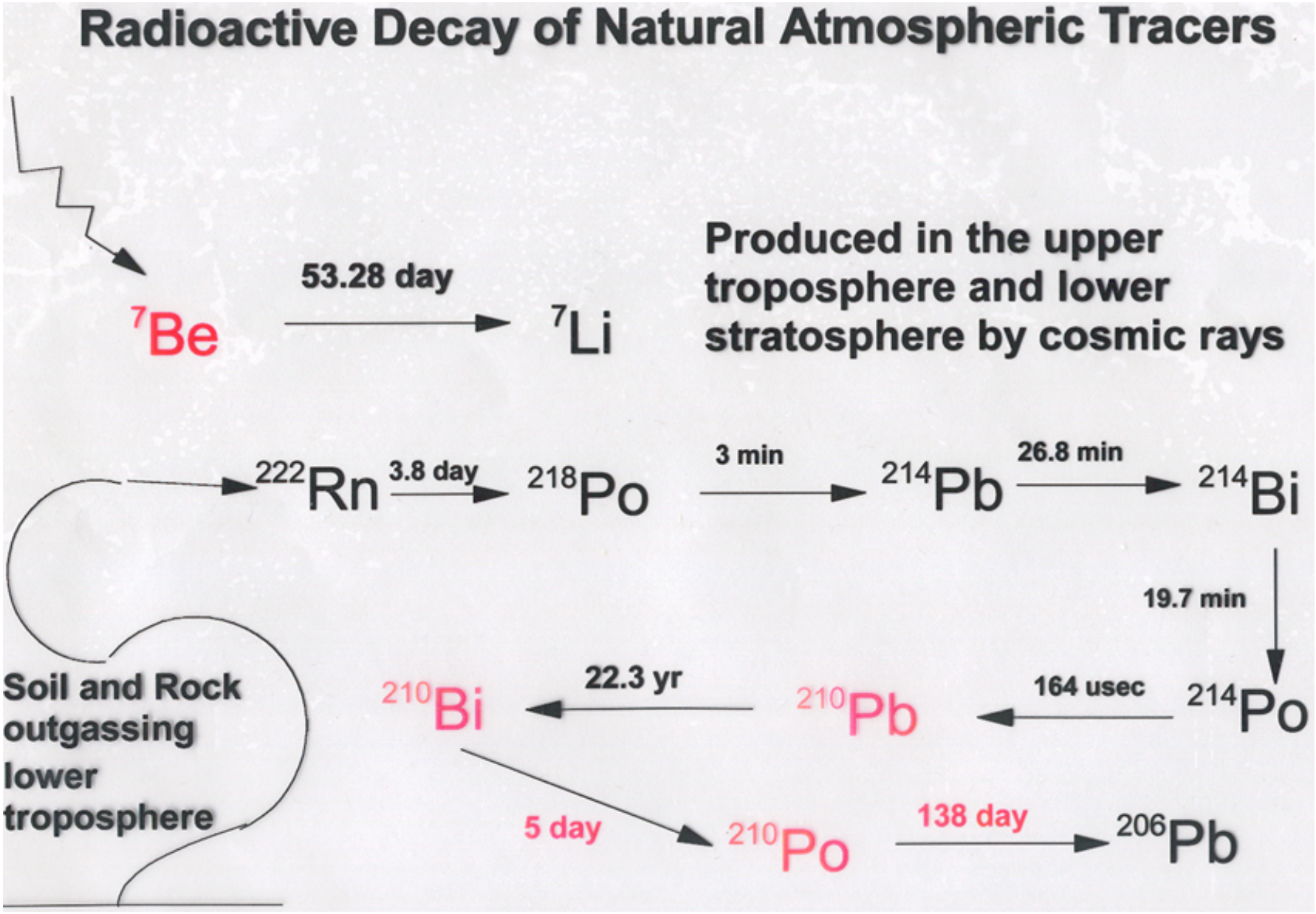
Natural Radionuclides in Mexico City Aerosols

Jeff Gaffney and Nancy Marley
University of Arkansas at Little Rock

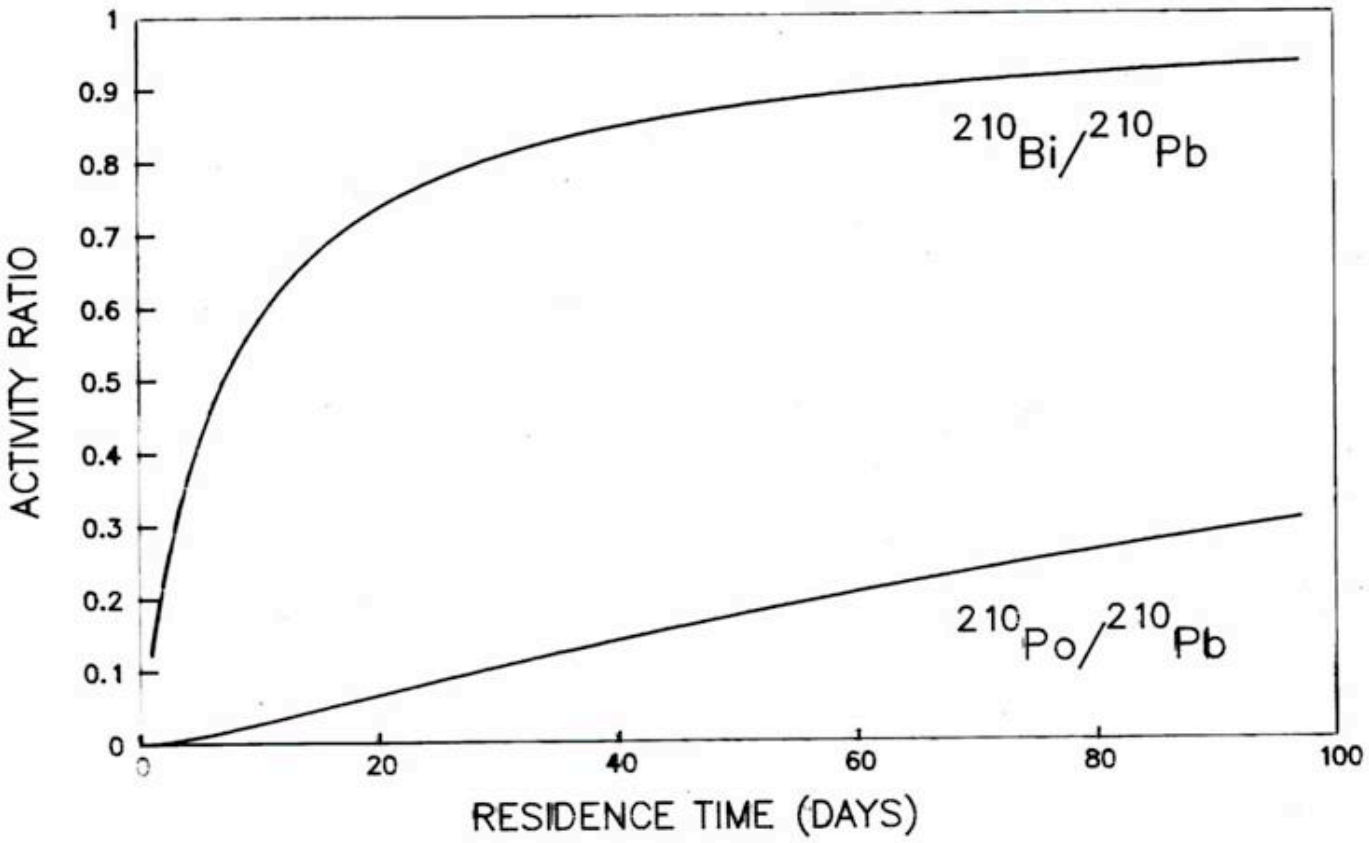
NATURAL RADIONUCLIDE TRACERS



Radioactive Decay of Natural Atmospheric Tracers



Activity Ratio vs Residence Time for Aerosols Removed in Precipitation



(adapted from Nevissi, A.E. 1991, J. Radioanal. Nucl. Chem.)

MEGACITIES

➢*10 Million*

1950 – 1 (NYC)

1995 – 14

2015 – 21

Mini – MEGACITIES

5 Million – 10 Million

1995 – 7

2015 – 37

ASIA – AFRICA

2/3 rural to ½ urban by 2025

MILAGRO - March 2006

Megacity Initiative - Local and Global Research Observations

MCMA-2006 – *Mexico City Metropolitan Area – 2006*

Lead Scientist – Luisa Molina (Molina Center for Energy and Environment, MIT)

Adrian Fernandez – Instituto Nacional de Ecologia

MAX-Mex – ***Megacity Aerosol Experiment – Mexico City***

DOE: Lead Scientist, Jeff Gaffney (ANL, UALR)

Program Managers: Rickey Petty, Ashley Williamson

MIRAGE-Mex – *Megacity Impacts on Regional and Global Environments – Mexico City*

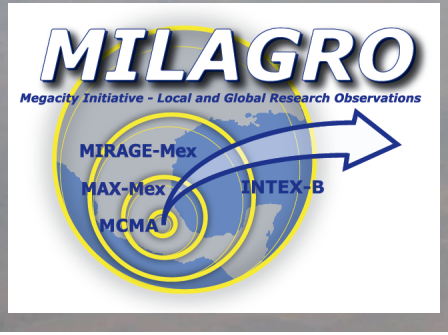
NSF: Lead Scientist, Sasha Madronich (NCAR)

Program Manager, Anne-Marie Schmoltner

INTEX-B – *Intercontinental Chemical Transport Experiment (NASA, NSF)*

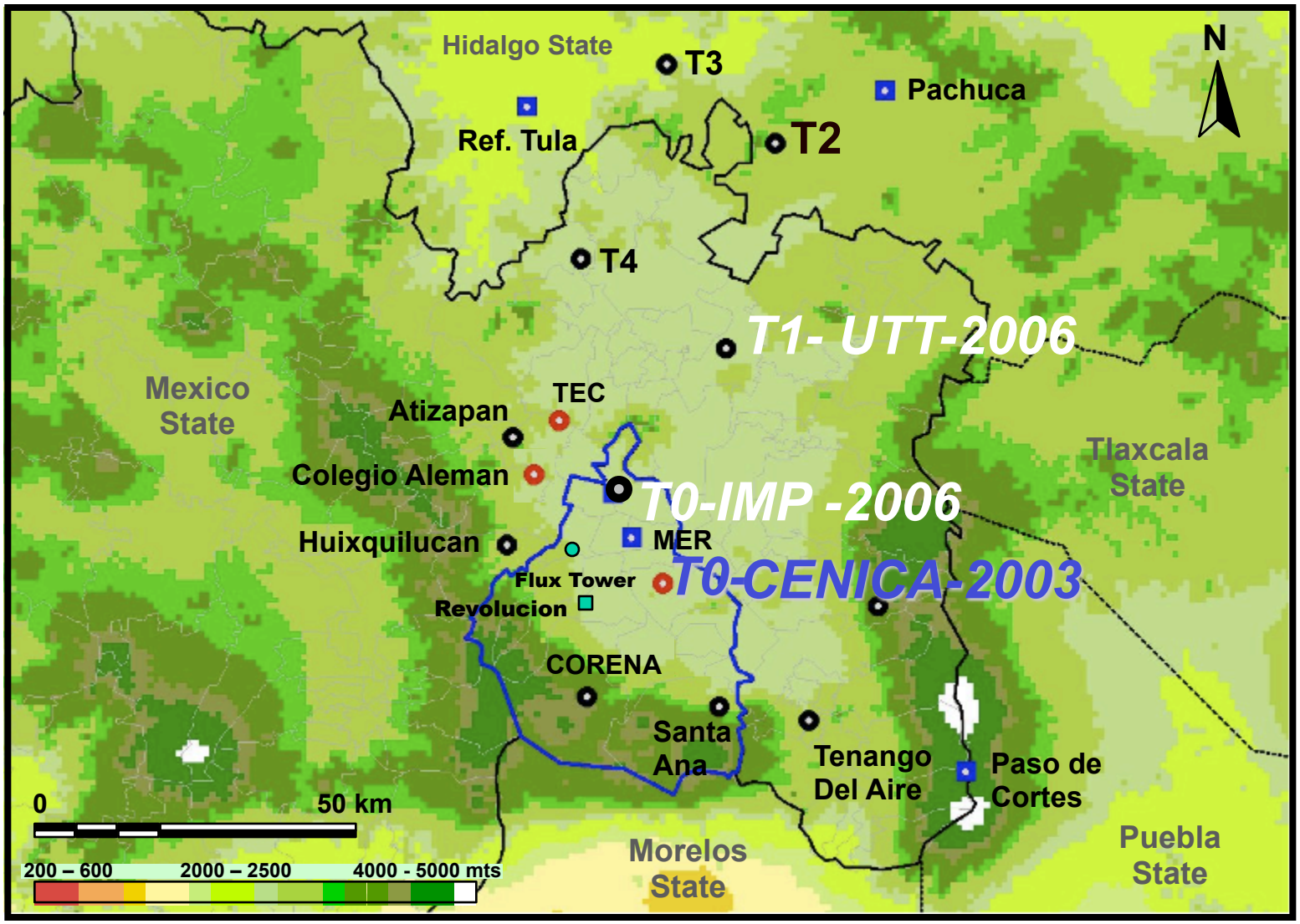
NASA: Lead Scientist, Hanwant Singh

Program Manager, Bruce Doddridge

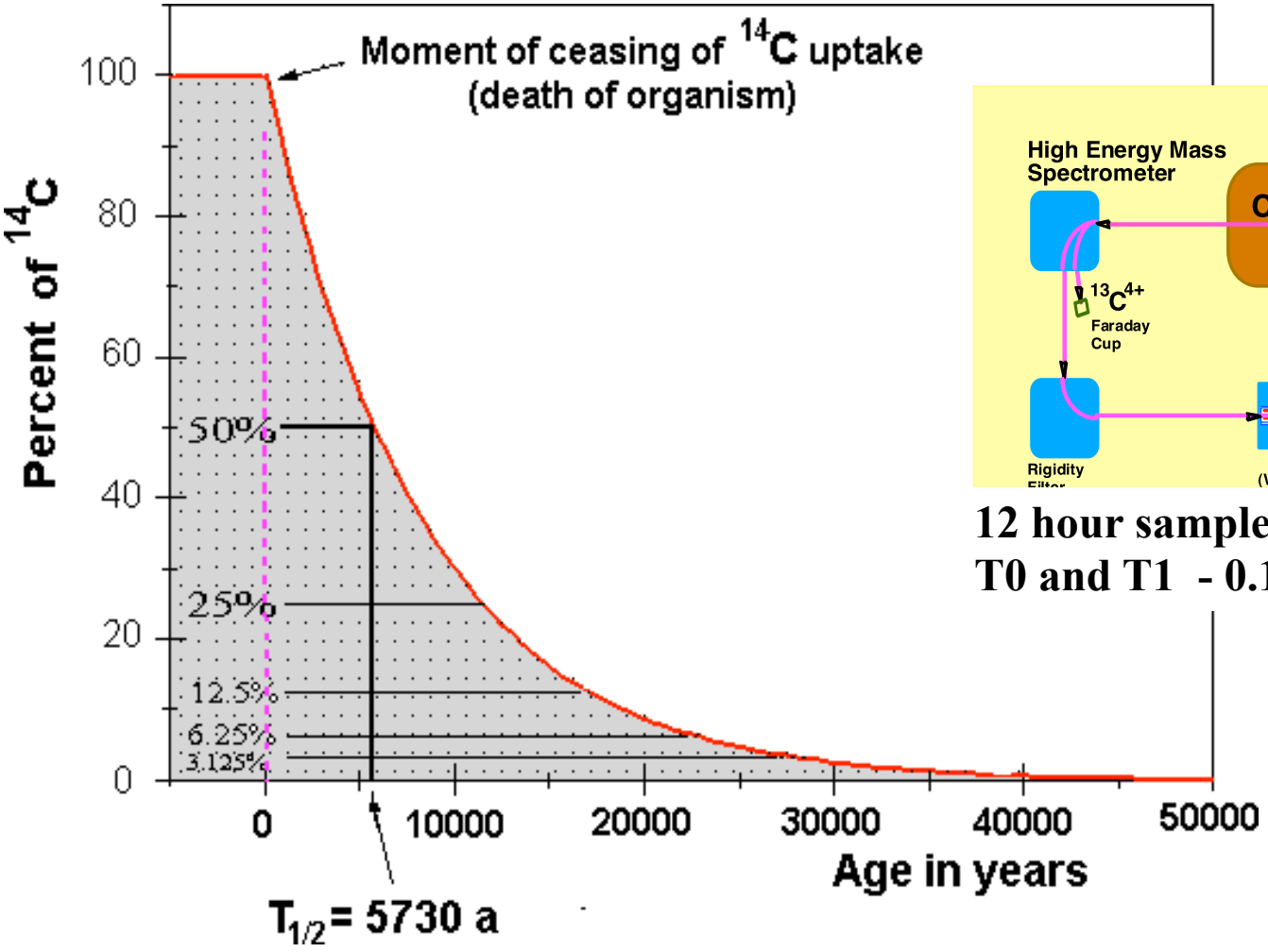


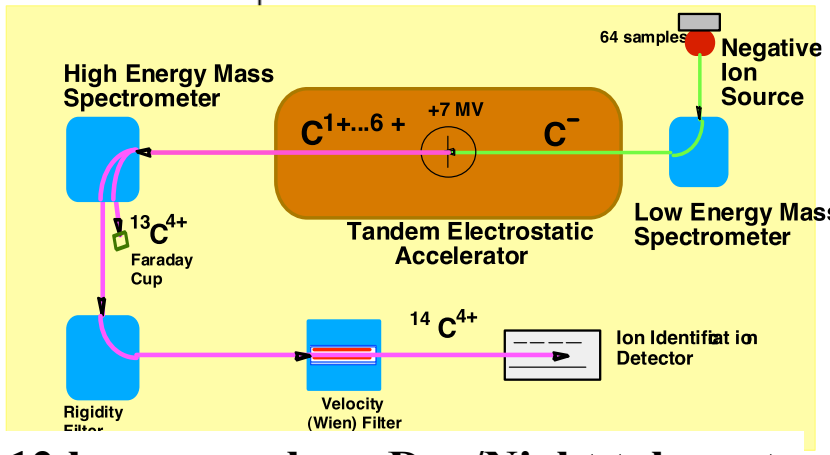
MCE²

MILAGRO Measurement Sites – 12 hour samples day/night



^{14}C --- Useful Tracer for Biomass vs. Fossil Organic Sources

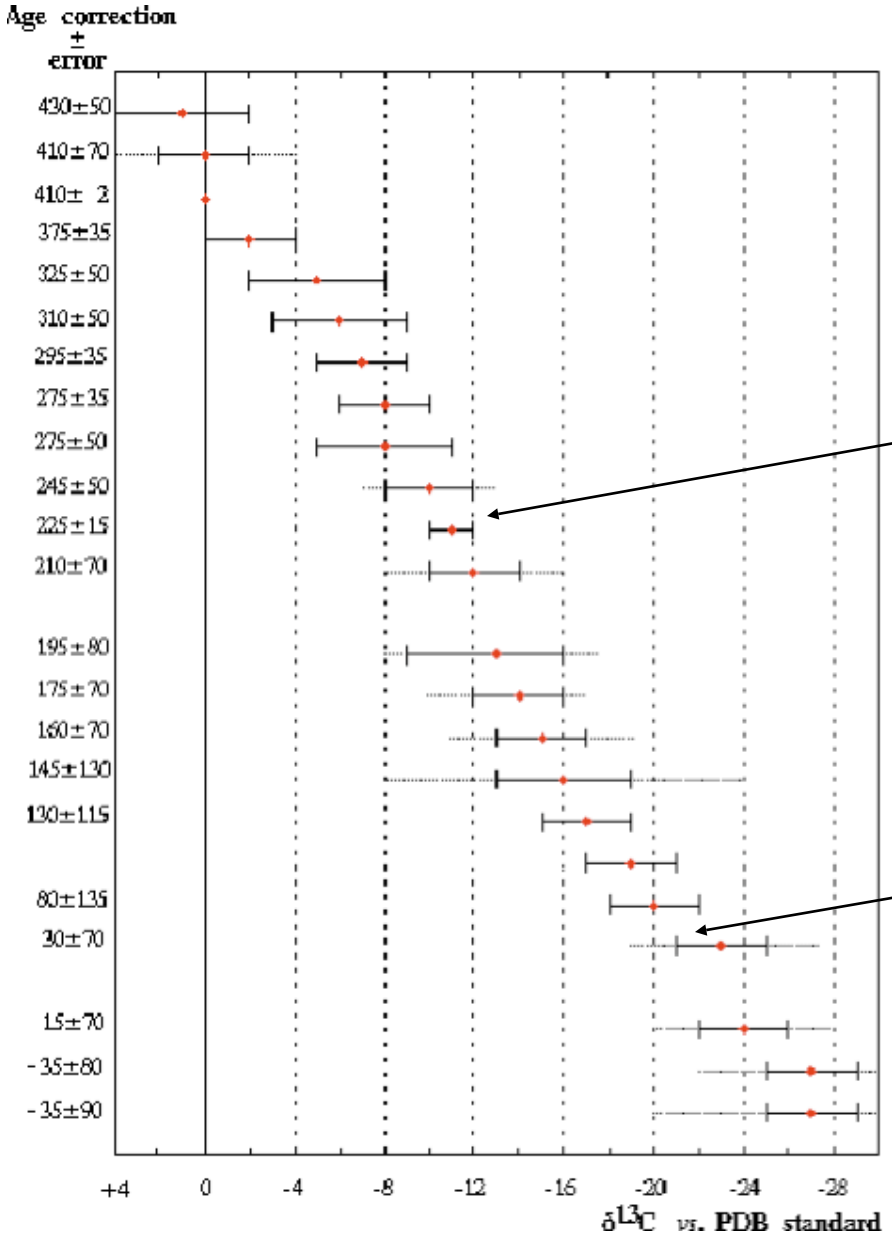




12 hour samples – Day/Night taken at T0 and T1 - 0.1 to 1.0 micron- CAMS

Biomass is labeled --- Fossil Fuel is 0 (millions of years old)

Carbon-13 also determined – for Initial Fractionation - USEFUL



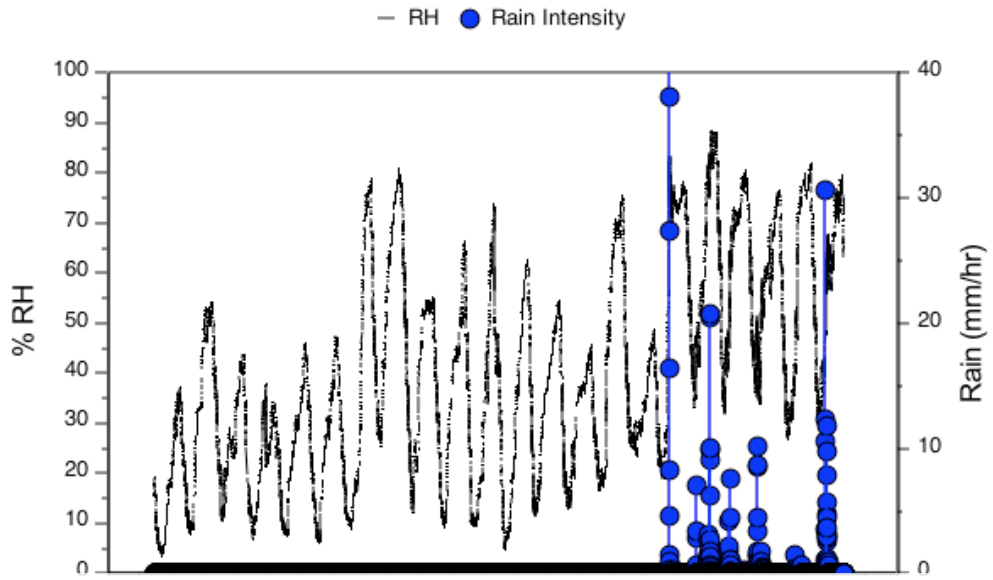
Marine HCO_3^-, CO_3
Saline lacustrine CO_3
PDB $\delta^{13}C$ standard
Bone apatite (C-4 diet)
Soil CO_3 (speleothems, nodules)
Freshwater shells
Bone collagen (C-4)
Atmospheric CO_2
Terrestrial snail shells
C-4 plants (maize, sorghum etc.)
ANU sucrose (^{14}C standard)
Bone apatite (C-3 diet)
freshwater marine plants
Grasses arid zone, sedges, papyrus
Straws, flax
Organic marine organisms
Submerged freshwater plants
Succulents (cactus, pineapple)
Oxalic acid (^{14}C standard)
Bone collagen, wood (C-3 diet)
C-3 plants (wheat, oats, rice, etc.)
graphite, coal
Wood, charcoal
Tree leaves, straw
Peats, humus

C-4

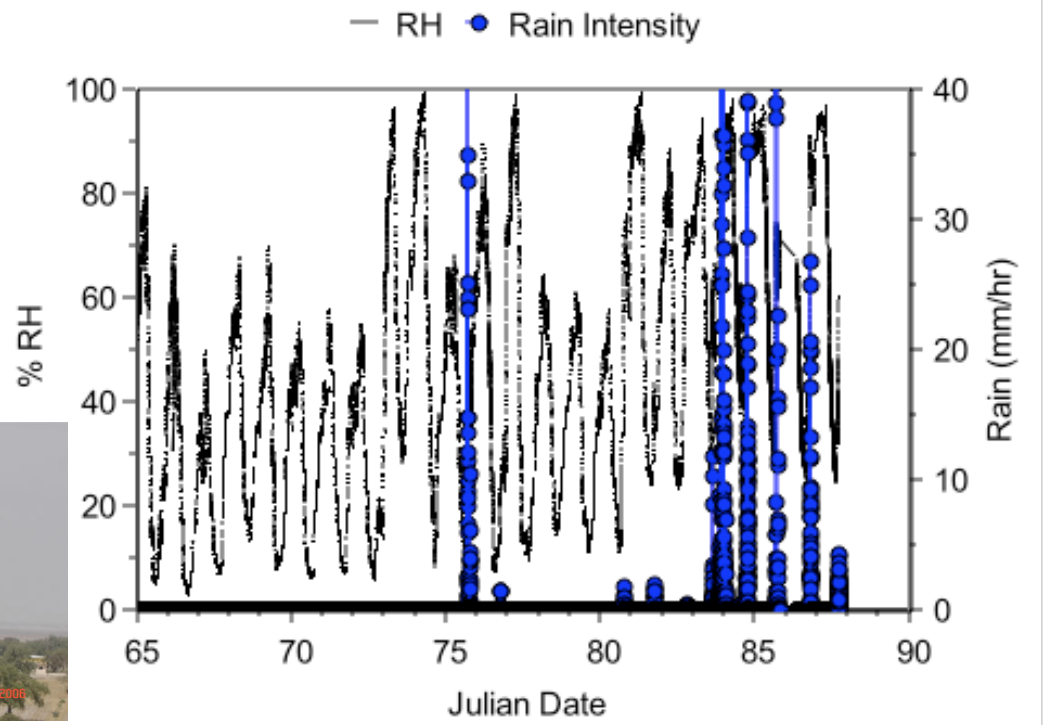
C-3

Examples of stable carbon isotopic variation in different sources and ^{14}C correction values. (From M. Stuiver and H.A. Polach, Radiocarbon, 19, 355-363, (1977))

T0



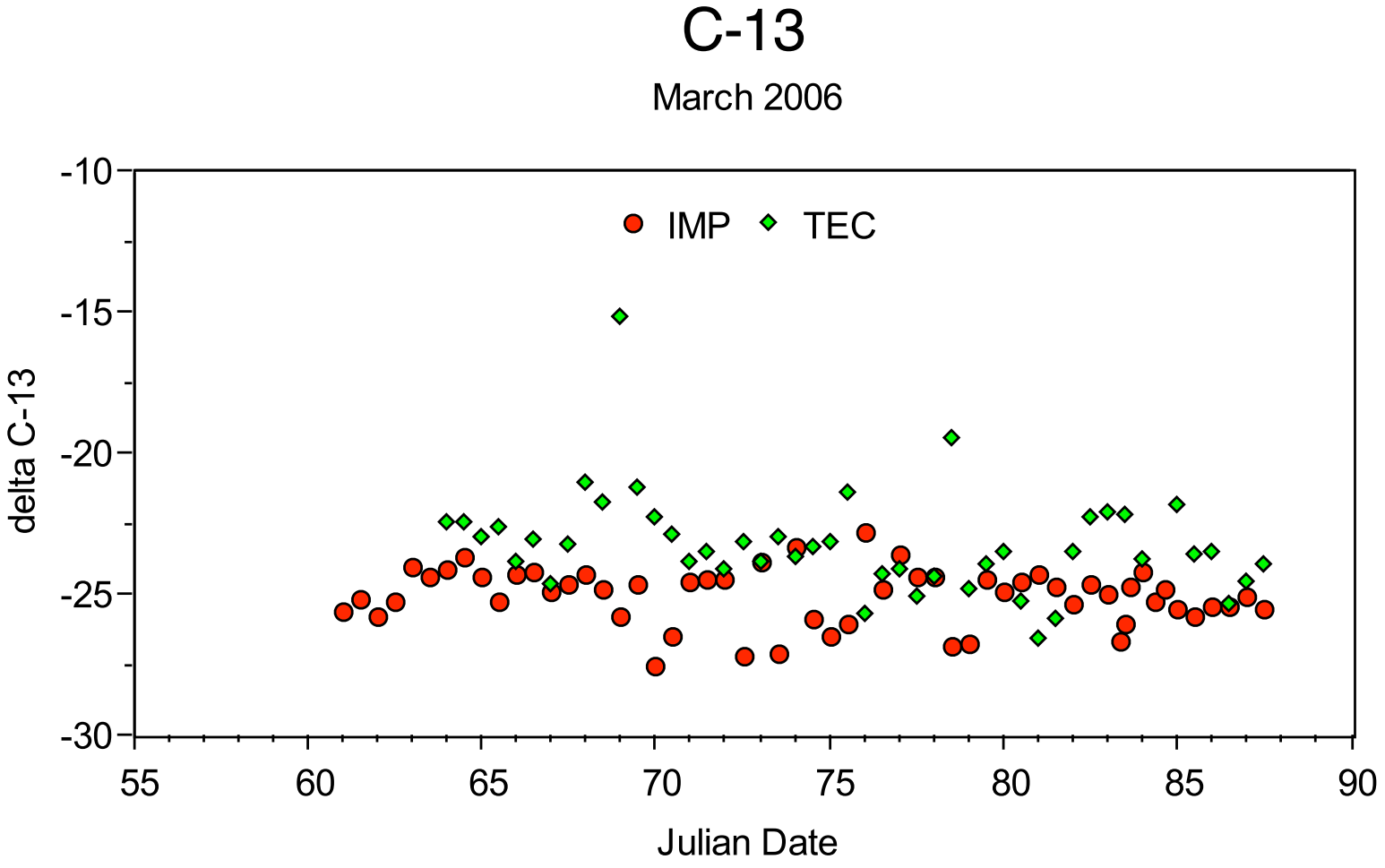
T1



RAIN EVENTS

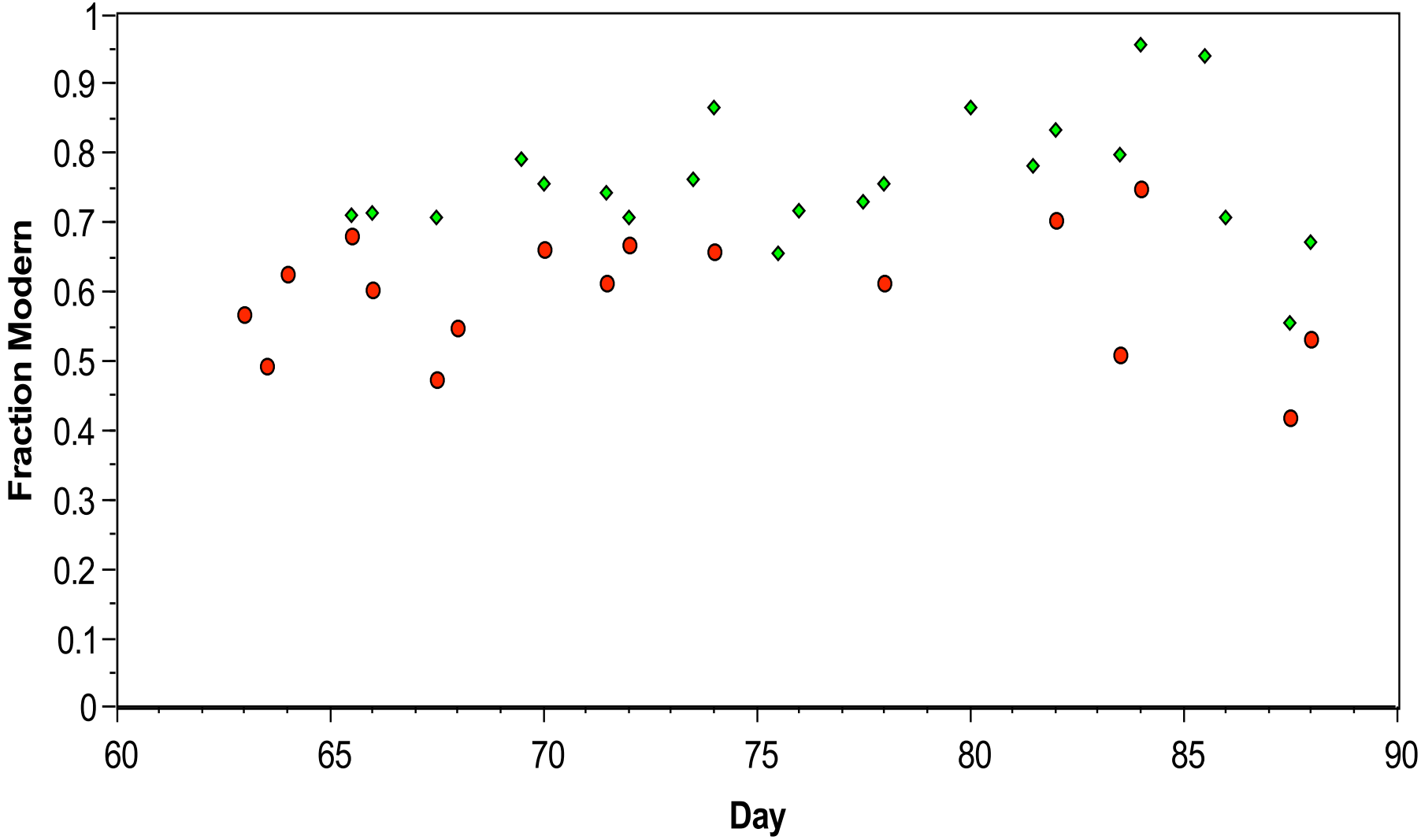
AT END OF STUDY!

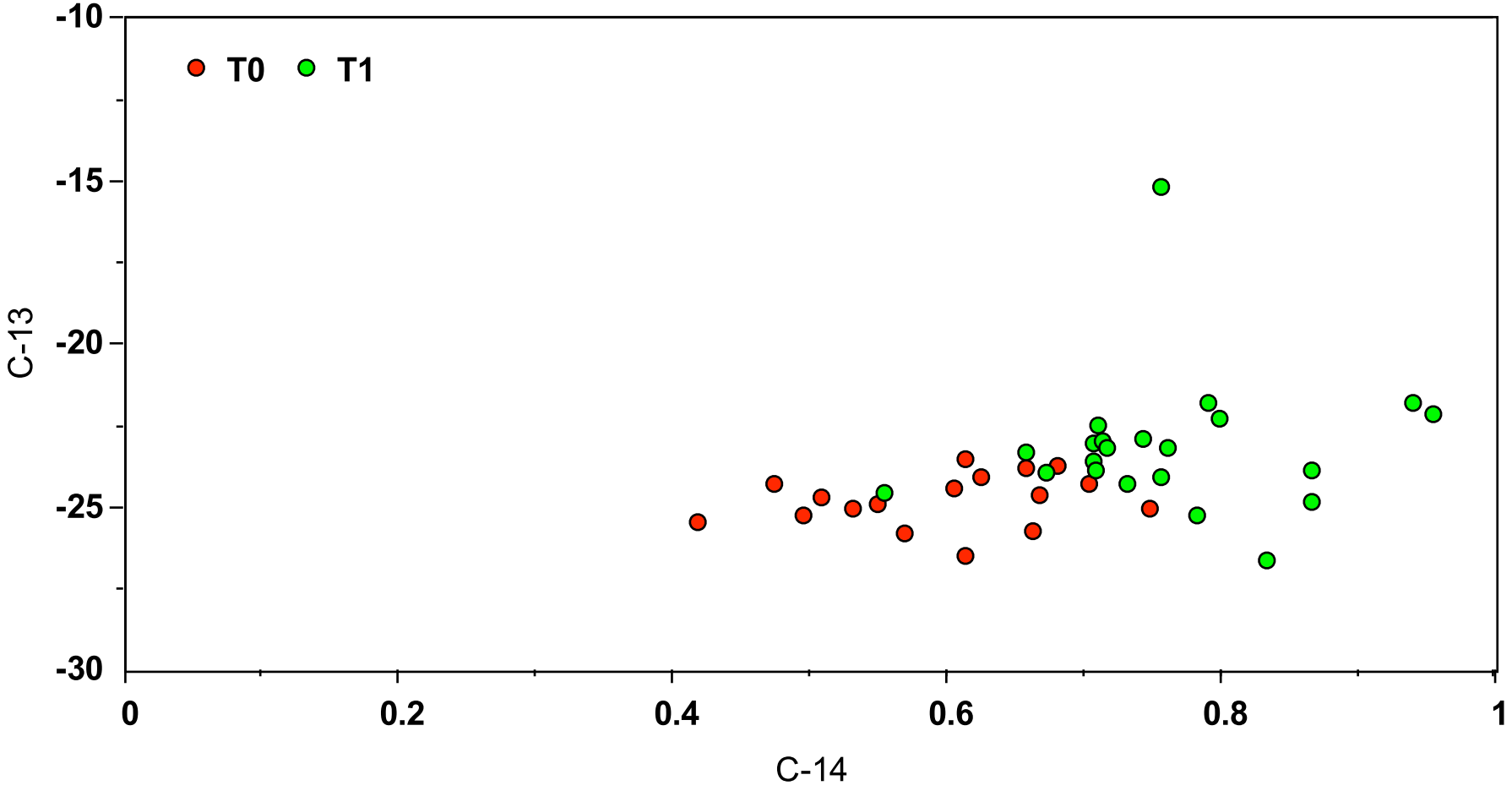
GRASS FIRES



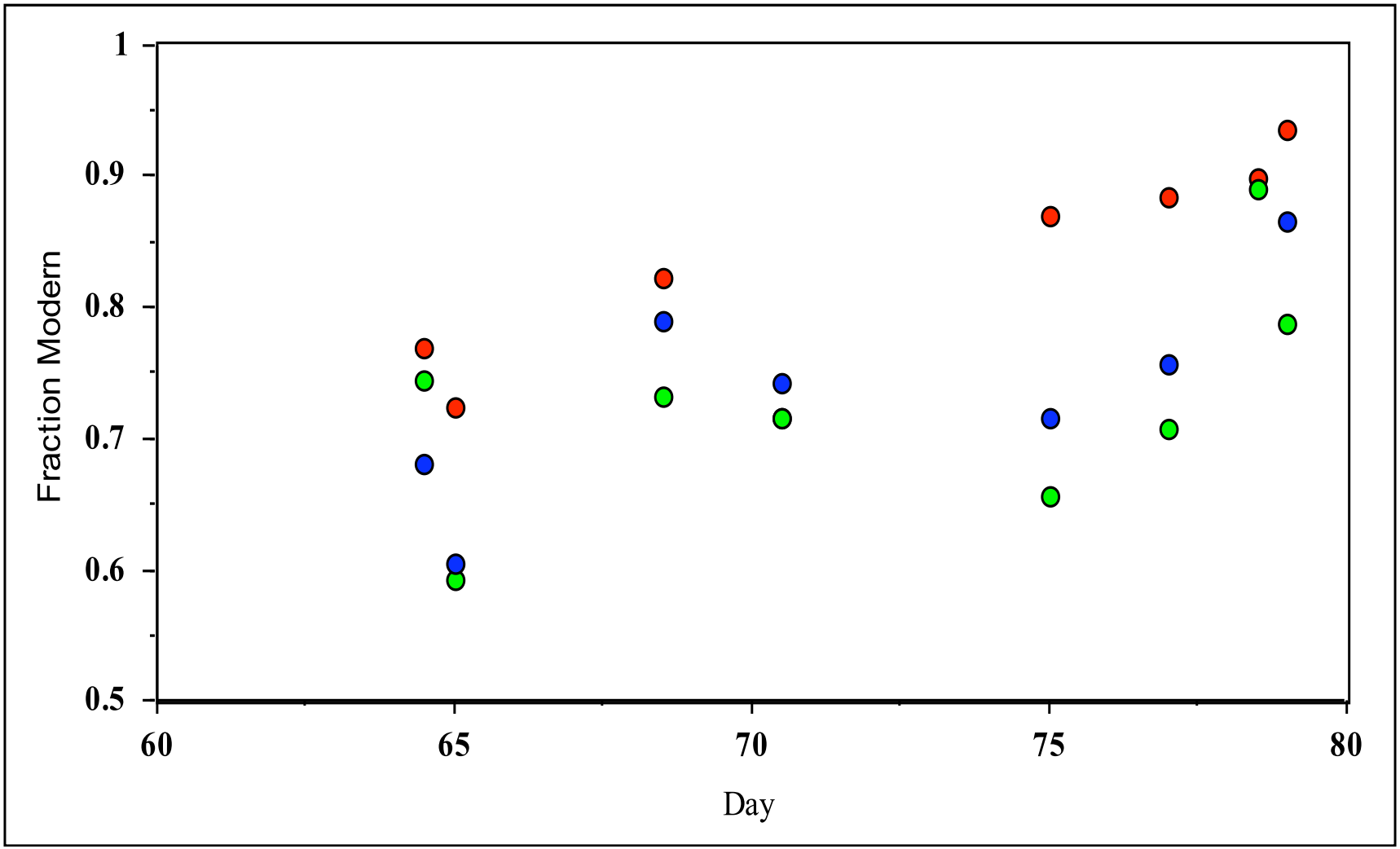
Delta 13C in 12-hour aerosol samples collected at sitesT0 (red) and T1 (green) during MILAGRO.

Fraction of modern carbon in 12-hour aerosol samples collected at site T0 (red) and T1 (green) during MILAGRO.

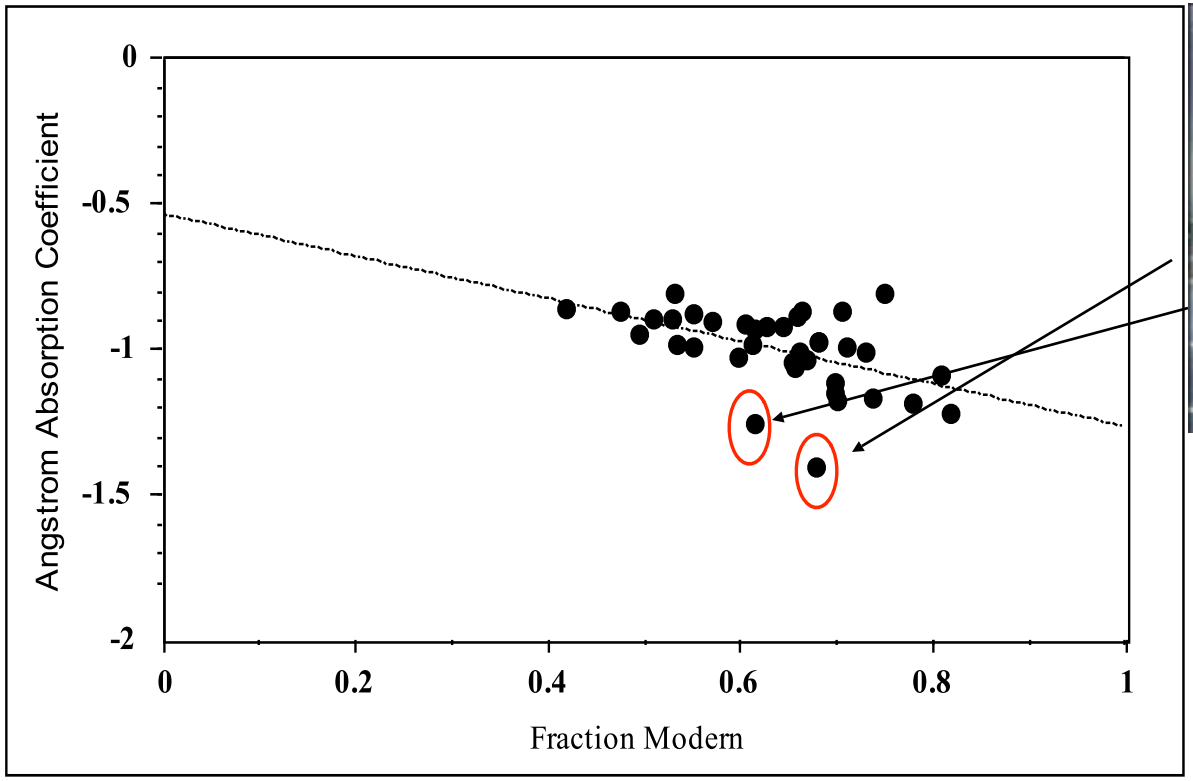


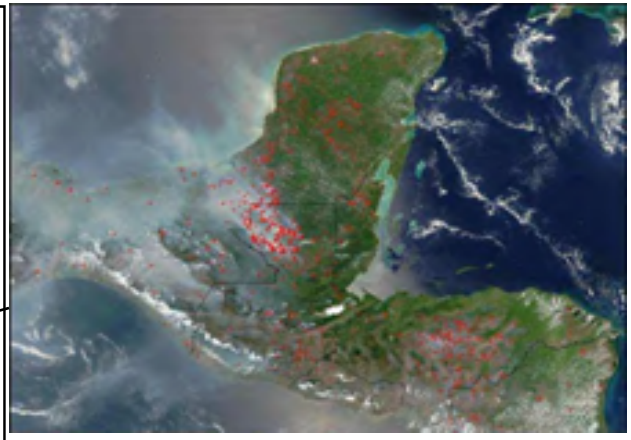


Carbon-13 as a function of carbon-14 content in 12-hour aerosol samples collected at site T0 (red) and T1 (green) during MILAGRO



Preliminary Results - Fraction of modern carbon in organic carbon (red) [400 C] elemental carbon (green) [700 C], and total carbon (blue) fractions of 12-hour aerosol samples collected at site T0 and T1 during MILAGRO.





Satellite image of the wildfires in the Yucatan April 2003.

Ångstrom Absorption Coefficient versus fraction modern carbon in fine aerosols at sites T0 (2003 and 2006) and T1 (2006). Day = red, night = blue. Circled values were for two samples collected during a major biomass event in 2003 where Yucatan fires impacted Mexico City (Massie, et al, 2006).

SUMMARY

Significant Amounts of Primary and Secondary Organic Aerosol in Fine Fraction Aerosol Mass Spectrometer and other data indicate 50% or more.

Significant Fraction of this Aerosol is from Recent Carbon – Indicating Local and Regional Biomass burning – including trash and agricultural – are contributing to the submicron aerosol in a major fashion.

C-13 data consistent with more impact from grass fires (C-4) at T-1

Higher values for C14 at T1 as compared to T0 (Mexico City) – indicating Regional Biomass burning is significant. 50% Recent in Mexico City –T0 site indicating significant background from biomass burning.

Mexico City and Region have Strong Biomass and/or trash burning components that are absorbing aerosols (BEYOND BC).

Biomass and trash burning – enhanced UV absorption due to HULIS

Grass Fires.. Vs Wood fires – different absorption in UV

Primary – HULIS and SOA similar properties- need better tracers in combination with C-13, C-14 data. N-15 data being examined currently.

ACKNOWLEDGEMENT

This work was conducted as part of the Department of Energy's Atmospheric Science Program as part of the Megacity Aerosol Experiment – Mexico City during MILAGRO. This research was supported by the Office of Science (BER), U.S. Department of Energy Grant No. DE-FG02-07ER64328. We wish to thank Mr. Rick Petty and Dr. Ashley Williamson of OBER for their continuing encouragement. We also wish to thank Mexican Scientists and students for their assistance from the Instituto Mexicano de Petroleo (IMP) and CENICA and the Technical University at Tecamac.